



Main complications of total hip arthroplasty: A systematic review



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ABSTRACT

Objective: The general objective of the present study is to analyze the scientific production on the complications of total hip arthroplasty, seeking to identify the main postoperative pathologies, as well as the main methods used in the treatment of these complications. **Methodology:** This is a systematic review focused on understanding the main aspects of complications of total hip arthroplasty. The research was guided by the question: "What are the main aspects that permeate the surgical methods in the performance of Hip Arthroplasty, as well as what are its main complications in clinical practice?" To find answers, searches were performed in the PubMed database using four descriptors combined with the Boolean term "AND": Arthroplasty, Replacement, Hip, Postoperative Complications, Intraoperative Complications, Prognosis and Hip Prosthesis. From this search, 520 articles were found. 17 articles were selected for analysis. **Results:** Recent advances, such as the direct anterior approach and the use of tranexamic acid to control blood loss, have improved outcomes. However, challenges persist, such as prosthesis-associated infection (PJI) and postoperative neuropsychiatric complications. **Conclusion:** Continuous research and judicious application of these approaches are essential to optimize outcomes and promote the health of patients undergoing THA.

Keywords: Total Hip Arthroplasty, Complications, Postoperative.

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INTRODUCTION

Total hip arthroplasty (THA) is an orthopedic prosthesis, whose application began in 1981 in Germany. When Glück introduced the use of ivory to replace femoral heads in patients whose hip joints had been destroyed by tuberculosis. Over the years, there was an evolution in the material used, until in 1960, Sir John Charnley developed low-friction arthroplasty, a total hip prosthesis, which is widely used today. This technique represents a viable alternative for the anatomical replacement of the femoral head and acetabular component with functional alterations, by means of organic materials. According to the literature, it is a successful surgery, and is considered a means of effective surgical intervention in functional recovery (ANDRADE. et al; 2023).

Epidemiological statistics indicate that THA has grown on a global scale. In the United States, for example, it was projected that the annual number of THAs performed could exceed 635,000 by the year 2030, showing a significant increase in relation to 2005 data, which reported approximately 193,000 annual procedures. In the United Kingdom, reports from the National Joint Registry also show an increase in THA rates in recent years. In Brazil and other developing countries, the demand for THA has also been increasing, although accessibility to surgery may be affected by socioeconomic factors and healthcare infrastructure. (ZUCOLOTTI. et al; 2023)

The aging of the population imposes significant challenges to the health system with regard to orthopedic surgeries, especially due to the increase in degenerative joint diseases and the higher incidence of falls in this population. In the Brazilian context, among the pathologies that influence the decision for surgical treatment of hip arthroplasty (partial or total) are fractures of the proximal femur, congenital deformities and coxarthrosis. Hip osteoarthritis, popularly known as coxarthrosis, is one of the leading causes of disability in the world, affecting more than 500 million people. The destruction of the joint component compromises biomechanics, causing pain, joint stiffness, muscle dysfunction, gait delay or impairment, which can progress to functional limitation and even disability of the hip joint (ANDRADE. et al; 2023) (REGOLIN. et al; 2022).

Fractures of the proximal femur have a high incidence and are associated with increased morbidity and mortality rates. About 50% of these fractures occur in the femoral neck region, while femoral head, trochanteric and subtrochanteric fractures make up the other 50%. Fractures of the femoral neck in patients over 60 years of age are associated with low-energy trauma and decreased bone density (osteoporosis). In individuals under 60 years of age, this type of fracture is related to higher-energy trauma and associated systemic injuries. The incidence of this type of fracture has increased over the years due to the higher life expectancy of the population, with women over 60 years of age being the most affected. (ANDRADE. et al; 2023)

Total hip arthroplasty (THA) is one of the most efficient orthopedic procedures. It relieves pain, restores joint mobility and improves the patient's quality of life. It allows patients to resume

their daily social and professional activities. Consequently, it is currently the most effective approach to treat several chronic conditions that affect the hip, including advanced degenerative diseases, avascular necrosis, and some trauma. (KOSTEWICZ. et al; 2022)

This systematic review article aims to compile and analyze the scientific evidence on the surgical techniques of Hip Arthroplasty, as well as its complications. The objective is to provide a comprehensive and up-to-date view, which synthesizes existing knowledge and identifies gaps in research, guiding future investigations and clinical practices. In-depth analysis of the evidence is intended to be a useful resource for healthcare professionals, researchers, and academics, contributing to the improvement of diagnostic and therapeutic approaches.

METHODOLOGY

This is a systematic review that seeks to understand the main aspects of hip arthroplasty, as well as to demonstrate the main techniques used in medical practice, as well as their complications. For the development of this research, a guiding question was elaborated through the PVO strategy (population, variable and objective): "What are the main aspects that permeate the surgical methods in the performance of Hip Arthroplasty, as well as what are its main complications in clinical practice?"

The searches were carried out through searches in the PubMed Central (PMC) databases. Five descriptors were used in combination with the Boolean term "AND": Arthroplasty, Replacement, Hip, Postoperative Complications, Intraoperative Complications, Prognosis, and Hip Prosthesis. The search strategy used in the PMC database was: (Arthroplasty, Replacement, Hip) AND (Postoperative Complications); (Arthroplasty, Replacement, Hip) AND (Intraoperative Complications) ; (Arthroplasty, Replacement, Hip) AND (Postoperative Complications) AND (Prognosis) and (Hip Prosthesis) AND (Postoperative Complications) AND (Prognosis). From this search, 520 articles were found, which were subsequently submitted to the selection criteria. The inclusion criteria were: articles in English, Portuguese and Spanish; published in the period from 2019 to 2024 and that addressed the themes proposed for this research, in addition, review, observational and experimental studies, made available in full. The exclusion criteria were: duplicate articles, available in the form of abstracts, that did not directly address the proposal studied and that did not meet the other inclusion criteria.

After associating the descriptors used in the searched databases, a total of 520 articles were found. After applying the inclusion and exclusion criteria, 44 articles were selected from the PubMed database, and a total of 17 studies were used to compose the collection.

DISCUSSION

Total hip arthroplasty (THA) is the standard treatment of excellence for end-stage osteoarthritis. THA surgery has made a major leap forward in patient functionality over the past fifty years. Several surgical techniques are applied in THA surgery, but there is little evidence about which technique offers the most benefits. On the one hand, the direct anterior approach (DAA) is considered a true minimally invasive technique because it results in a lower amount of muscle damage, since the operation is performed through a small incision and a space between the muscles in the hip joint. In THA, an ADA approach allows access to the hip muscles through internerve and intermuscular pathways, and has gained popularity. Compared to other approaches, DAA has advantages such as faster recovery, less pain, and a lower rate of postoperative dislocation. (SHI. et al; 2019)

The direct anterior approach (DAA) for total hip arthroplasty has become popular in the last decade as a minimally invasive technique used by many surgeons, including the authors, to preserve the integrity of muscle groups and their insertions and the dynamic stability of the hip, resulting in less surgical trauma and a faster recovery process with reduced postoperative pain. This surgical approach presents a variety of complications and pitfalls. The most frequently reported complication after DAA is sensory nerve dysfunction (2.8%). The mechanism of injury is related to the dissection under the incision in the skin and the placement of the retractor during acetabular milling. The lateral femoral cutaneous nerve (LFCN) arises approximately 11 mm laterally from the space between the sartorius muscles and the tensor fasciae latae (TFL) or sartorial substance. (FERNÁNDEZ-PALOMO; GONZÁLEZ-POLA, 2024)

Another complication of DAA is injury to the femoral neurovascular bundle. There are two main times when the femoral neurovascular bundle can be injured. In the initial approach, not identifying the sartorius muscle and confusing it with the TFL will force a medial dissection of it, leading to an entry into the femoral triangle. One possible cause is if the sartorius is confused with the TFL at the beginning of the procedure. The dissection will then fall medially to the sartorius and enter the femoral triangle, with the inherent risk of damage to the contents of the triangle. The key here is the identification of the TFL, which can be identified initially by being the most lateral abdominal muscle and its distinctive white fascial sheath that visibly thickens as it moves laterally towards the fascia over the gluteus medius. These landmarks can help confirm the correct location of the TFL and subsequent placement of the fascial incision. Secondly, femoral nerve injury can also occur through incorrect placement of retractors. When placed too deeply and over the anterior edge of the acetabulum, the femoral nerve can be inadvertently compressed, leading to neuropraxia. In our series, we had a 90-year-old female patient with femoral arterial thrombosis, who required emergency surgical treatment. Again, keeping the retractors immediately intra- or extracapsular is

crucial to avoid compression. Staying immediately adjacent to the bone and capsule at the midpoint of the anterior acetabulum is the best method of prevention. (FERNÁNDEZ-PALOMO; GONZÁLEZ-POLA, 2024)

On the other hand, the conventional posterior approach (AP) is the most commonly used surgical technique for THA. (PENG. et al; 2020) The conventional PA approach has proven efficacy and is the most widely used form due to the ease of manipulation, clear intraoperative visual field exposure, and stable postoperative outcomes. However, it is not compatible with the current demands and expectations of fast, more precise, safer, and less invasive rehabilitation. In recent years, the increasing diffusion of the concept of tissue-sparing surgery has promoted the development of several minimally invasive techniques for THA surgery, including the minimally invasive anterolateral approach (MAA), direct anterior approach (AAD), mini-posterior approach, and percutaneous assisted supercapsular approach (SuperPath®, Microport-Shanghai, China). Minimally invasive techniques aim to reduce soft tissue and muscle damage, improve postoperative recovery, and decrease surgical scar length and impact on patients' aesthetic perception. The percutaneously assisted supercapsular total hip (SuperPATH, SP) is an emerging THA technique, which is a minimally invasive approach based on the posterolateral technique. The minimally invasive procedure has the advantage of reducing infection, dislocation, intraoperative bleeding, speeding up recovery, and PS does not require cutting of the muscles around the hip joint, and the hip joint capsule is preserved intact. However, there is still a lack of high-quality evidence to support the superiority of the minimally invasive approach, so the choice between the traditional approach and PS is highly controversial in terms of which will provide better benefits for the adult patient. (ZHAO. et al; 2024) (SOLARINO. et al; 2022)

Hip arthroplasty is divided into THA and hemiarthroplasty (HA), THA requires replacement of the femoral head and acetabulum. Compared to THA, HA only replaces the femoral head, which requires less technical skill from the surgeon. The advantages of HA include less surgical trauma, less blood loss, and reduced economic cost; The disadvantages are a high incidence of postoperative pain and greater wear and tear of untreated acetabular cartilage. (LI; LUO, 2021)

Total hip replacement (THA) is known as the "Operation of the Century," revolutionizing treatment for people with disabling hip arthritis. Precise orientation and positioning of the acetabular cup in total hip arthroplasty (THA) is crucial for satisfactory results. Incorrect positioning of the acetabular cup can result in displacement, accelerated implant wear, osteolysis leading to aseptic cup loosening, impingement, or discrepancy in limb length. The orientation of the acetabular cup is significantly influenced by the intraoperative position of the patient's pelvis during THA. Some studies suggest that the use of mechanical guides is superior to freehand techniques for proper acetabular cup placement. The additional use of preoperative computed topography and 3D printing

of custom acetabular jigs decreases the incidence of acetabular cup malposition during THA. (SAI SATHIKUMAR. et al; 2023)

Over the past 44 years, the most popular "safe zones" for acetabular cup placement have been described by Lewinnek et al. The Lewinnek safe zone was described based on a series of 300 THAs and defined the acetabular tilt within 40 +/- 10 degrees and the acetabular anteversion within 15 +/- 10 degrees. More recently, Callanan et al. described safe zones for dome placement, where 1,823 THAs were studied and it was suggested that the safe inclination of the acetabular dome should be between 30-45 degrees, this finding agreeing with the Lewinnek safe zone. In 2019, Dorr et al. published an editorial commentary titled "Lewinnek's Death: Safe Zone." He suggested the need for a "Functional Safe Zone" for the placement of the acetabular cup over the traditional Lewinnek safe zone. The concept of a functional safe zone refers to a patient-specific safe zone to avoid instability or impact that depends on several patient-specific factors. However, instability or impact with respect to the Lewinnek safe zone has only been described in patients with abnormal spinopelvic mobility. In cases where spinopelvic mobility cannot be assessed, for example in an acute femoral neck fracture, where THA is the intended treatment, assessment of spinopelvic mobility with seated and standing radiographs is not possible. In such situations, the safe zones of Lewinnek or Callanan remain an important guide. Therefore, the Lewinnek or Callanan safe zones remain applicable for acetabular cup placement in patients where any abnormal spinopelvic mobility has been ruled out preoperatively or where spinopelvic relationships cannot be assessed. (SAI SATHIKUMAR. et al; 2023)

Periprosthetic joint infection (PJI) is a serious complication that can arise after joint replacement surgery. It is often associated with the need for multiple revision surgeries, repeated infections, prolonged courses of antibiotics, prolonged hospital stays, delayed aseptic loosening, and poor functional outcomes. It is one of the most feared complications of total hip arthroplasty (THA), occurring in 0.3-2.9% of primary arthroplasties and in 2.1-15.3% of revision arthroplasties. In fact, in cases where joint revision is required, this complication accounts for 39.6% of all surgical procedures. (LONGO. et al; 2023) (LUPPI. et al; 2023)

Regarding risk factors, high BMI was the main risk factor for PJI. Obese patients are more likely to be at increased risk of PJI in the perioperative setting, which may be attributable to prolonged surgery and anesthesia time, higher risk of *C. avidum* colonization in the groin, longer hospital stay, and high rates of readmission within 30 days. In addition, obesity is often correlated with a higher presence of other comorbidities, including metabolic syndrome, wound dehiscence, and heart disease. In addition, DM and other comorbidities, such as AVN, RA, CVD, CPD, neurological diseases, opioid use, and AIDS were also essential risk factors for PJI. In contrast, dysplasia or dislocation and OA were protective factors. In addition, age, smoking, alcohol abuse, and other

medical conditions such as previous kidney disease, hypertension, cancer, steroid use, and liver disease were not correlated with the risk of PJI. (REN. et al; 2021)

Infections associated with prosthetic joints can be categorized into three groups: early infections (which occur within three months after surgery), late infections (which appear between three and 24 months after surgery), and late infections (which appear more than 24 months after surgery). The time of occurrence is associated with significant differences in the etiologic agent, since more virulent microorganisms, such as *S. aureus*, tend to cause earlier infections, whereas more indolent agents, such as coagulase-negative Staphylococci or *Cutibacterium acnes*, are responsible for late infections. (LONGO. et al; 2023) (LUPPI. et al; 2023)

The clinical presentation is related to pathogenesis, time of implantation onset, pathogen virulence, and host immune response. The presence of an open wound, sinus tract, or abscess is more common in patients with contiguous or acquired PJI in the perioperative period. On the other hand, systemic signs or symptoms, such as fever or chills, usually occur in patients with hematogenous infection. Although fever, chills, and joint erythema are highly specific, they are also insensitive to diagnosis. A sinus tract communicating with the joint or an exposed implant are the only fully specific findings, but have low sensitivity (20-30%). Joint pain and stiffness are the most sensitive clinical features, but they are also common in aseptic failures. Specifically, joint pain at rest is the most frequently reported symptom, but its specificity is low (28.3%). (LUPPI. et al; 2023)

Topical administration of powdered antibiotics is a simple intervention that some studies have suggested may reduce the risk of orthopedic infection and PJI. Administration of antibiotics to a target area allows for high concentrations of medications, while perhaps limiting the likelihood of systemic side effects, although claims about the frequency of side effects should be considered in light of the fact that most studies on the topic are insufficient. Potential drawbacks of topical antibiotics include complications in wound healing, reduced osteoblastic activity, wear and tear of foreign bodies, and contribution to antibiotic resistance. Although systemic absorption is lower when the powder antibiotic is used locally than with intravenous administration of antibiotics, complications such as allergy, ototoxicity, and nephrotoxicity are still possible. The proliferation of antibiotic-resistant organisms is also a concern. In THA, topical administration of vancomycin powder for primary prevention of PJI has been studied in several recent observational studies, but conclusions have been hampered by the low frequency of PJI and the high number of patients required to detect relevant differences. Some studies have found no benefit in preventing infections. (WONG. et al; 2021)

Different treatment strategies included surgical irrigation, debridement, antibiotic therapy, and implant retention (DAIR) with or without polyethylene exchange. Debridement involves the removal of hematoma, fibrous membranes, sinus tracts, and devitalized bones and soft tissues. Based on this

study, 970 patients were analyzed. Ten studies have specified their cohort joint in PAI relative to hip replacements or knee replacements, resulting in 454 total knees and 460 total hips. The age of the patients ranged from 18 to 92 years. Success rates for DAIR treatments in the next cohort ranged from 55.5% to a maximum of 90% (mean value 71%). Although the DAIR procedure is quite limited, it is still considered an effective option for patients who develop early postoperative or acute hematogenous IAP. However, there is a lack of studies, in particular randomised controlled trials (RCTs), comparing DAIR with one- and two-stage review protocols in the context of early PAIs, reflecting the need to conduct more high-quality studies to address the problem. (LONGO. et al; 2023)

The type of treatment depends on the timing of prosthesis implantation: within 4 to 6 weeks, in patients with good soft tissue coverage and joint stability and without sinus formation, debridement and retention of the implant is recommended, due to the good chances of eradicating the infection; According to the opinion of some authors, debridement and retention of the implant are viable surgical treatments for most patients with symptoms for less than 3 weeks, which also begin more than 3 months after arthroplasty, however, in these cases, the success rate is low when the causative agent is a *Staphylococcus* spp. (ZARDI; FRANCESCHI, 2020)

In the late and late stages, revision of the prosthesis is necessary due to the excessive formation of biofilm that prevents the bacterial load from being simply reduced through antibiotic therapy. In both cases, intravenous antibiotic therapy should be initiated immediately and continued for two to six weeks based on culture tests or epidemiological data from isolated microorganisms (the most common are *Staphylococcus aureus*, coagulase-negative staphylococci and streptococci, but also *Cutibacterium acnes* and Gram-negative pathogens play a role). Then, prolonged oral antimicrobial treatment may be needed to control the infection. In the early stages, as the biofilm is malformed, the bacterial load can be reduced more easily. In any case, rupture and removal of as much biofilm as possible is mandatory for any successful implant retention procedure. In the late and late stages, the surgical approach is through one or two stage exchange with removal of the old prosthesis or cement spacer, debridement, culture collection, and placement of an antibiotic-loaded cement spacer in the joint space. Unless the infection clears, the external fixator is a reliable therapeutic option to achieve definitive control of the infection before attempting a new arthroplasty; Arthrodesis is another possibility when arthroplasty can no longer be performed due to the risk of persistent or relapsing infection. Unfortunately, if it is impossible to control IAP and there is a life-threatening condition, amputation of the affected limb can become a painful but inevitable choice. (ZARDI; FRANCESCHI, 2020)

Hip dislocation is a common complication after THA. Over the past 50 years, the global risk of displacement has been 1.7%; however, it has decreased from 3.7% in the 1970s to 0.7% in the last

decade. Analysis of annual rates of displacement has shown an improvement over the decades. The dislocation, whose problem lies in the loss of contact between the prosthetic head and its acetabulum, is due to an extreme position of the joint caused by the impact of excessive mechanical forces on the lower limb involved. It can occur with or without implant loosening, periprosthetic fractures, and infection. In most cases, technical errors during implant placement are responsible for the incidence. Preventive measures include activities aimed at the correct insertion of the implant and the choice of the most appropriate type of implant for the patient, according to their individual needs. (KOSTEWICZ. et al; 2022) (VAN ERP. et al; 2023)

Postoperative pain is a significant concern for patients undergoing primary total hip arthroplasty (THA). Patient outcomes including increased satisfaction, early participation in physical therapy, and a faster return to self-care are influenced by postoperative pain management. In addition, untreated acute pain is a predictor of chronic pain and disability, negatively impacting quality of life. Several economic benefits have also been associated with improved postoperative pain control, including early discharge, reduced need for walking assistance, reduced opioid use and opioid-related complications, and decreased thirty-day readmission rates. (DAI. et al; 2021)

THA is usually accompanied by perioperative blood loss, postoperative anemia, and allogeneic blood transfusion, which can delay postoperative functional recovery. Postoperative anemia and blood transfusion can result in increased morbidity and cost, immune reactions, disease transmission, infection, and even mortality. TXA, as an antifibrinolytic agent, which can promote clot stabilization through competitive inhibition of plasminogen activation, is able to reduce blood loss and the incidence of transfusions in THA. Many studies have shown that several forms of TXA delivery have been used by surgeons, including intravenous, topical, or oral routes. Most studies on the way TXA is administered in THA have focused on the intravenous, topically, or combined routes. Currently, several studies have demonstrated that oral administration of TXA had similar blood-saving effects as intravenous or topical TXA on THA, and other studies have reported that multiple doses of oral TXA were effective in reducing total blood loss and allogeneic blood transfusions compared to a single oral dose or control group on THA. (XU. et al; 2019)

Finally, postoperative delirium (POD) and postoperative cognitive dysfunction (POCD) are common complications after total hip arthroplasty (THA), affecting the length of hospital stay and increasing medical complications. Postoperative delirium is a psychotic phenomenon characterized by fluctuations in the patient's cognition and attention, which usually appears 1–3 days after surgery and can last for hours to days. Previous research has shown that the incidence of postoperative delirium in patients after pelvic surgery ranges from 10–60%. Key risk factors include older age, cognitive impairment, dementia, preoperative comorbidities, substance abuse, and fracture surgery. The diagnosis can be made using tools such as the confounding assessment method (CAM), which is



sensitive, specific, reliable, and easy to use to identify POD. Treatment consists of risk stratification and implementation of a prevention protocol with multiple components. POCD has a mean incidence of 19.3% at 1 week and 10% at 3 months. Risk factors include older age, elevated BMI, and cognitive impairment. Treatment includes reversal of risk factors and implementation of protocols to preserve physiological stability. POD and POCD are common and preventable complications. Risk stratification and targeted interventions can reduce the incidence of both syndromes. Every physician involved in the care of such patients should be alert to these complications. (KITSIS. et al; 2022) (ZHANG. et al; 2021)

CONCLUSION

In conclusion, total hip arthroplasty (THA) represents a milestone in the approach to end-stage osteoarthritis. Over the past few decades, surgical advances, such as the direct anterior approach (DAA) and the use of tranexamic acid (TXA) to control blood loss, have improved outcomes. However, prosthesis-associated infection (PJI) remains a complex challenge, requiring individualized treatment strategies. In addition, neuropsychiatric complications, such as postoperative delirium (POD) and postoperative cognitive dysfunction (POCD), deserve attention. Continuous research and judicious application of these approaches are essential to optimize outcomes and provide a healthier life for patients undergoing THA.



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